Introduction

In 1957, the Department published Bulletin 3, the *California Water Plan*. Bulletin 3 was followed by the Bulletin 160 series, published six times between 1966 and 1993, updating the *California Water Plan*. A 1991 amendment to the California Water Code directed the Department to update the plan every five years. Bulletin 160-98 is the latest in the series.

The Bulletin 160 series assesses California's agricultural, environmental, and urban water needs and evaluates water supplies, in order to quantify the gap between future water demands and the corresponding water supplies. The series presents a statewide overview of current water management activities and provides water managers with a framework for making water resources decisions.

While the basic scope of the Department's water plan updates has remained unchanged, each update has taken a distinct approach to water resources planning, reflecting issues or concerns at the time of its publication. In response to public comments on the last update, Bulletin 160-93, the 1998 update evaluates water management actions that could be implemented to improve California's water supply reliability. Bulletin 160-93 analyzed 2020 agricultural, environmental, and urban water demands in considerable detail. These demands, together with water supply information, have been updated for the 1998 Bulletin, which also uses a 2020 planning horizon. However, much of Bulletin 160-98 is devoted to identifying and analyzing options for improving water supply reliability. Water management options available to, and being considered by, local agencies form the building

The Department's Bulletin 160 series quantifies California's managed or dedicated water uses—urban, agricultural, and environmental uses. Unmanaged uses, such as the precipitation consumed by native plants, are not quantified.

blocks of evaluations prepared for each of the State's ten major hydrologic regions. (Water supplies provided by local agencies represent about 70 percent of California's developed water supplies.) These potential local options are integrated with options that are statewide in scope, such as the CALFED Bay-Delta program, to create a statewide evaluation.

The statewide evaluation represents a snapshot, at an appraisal level of detail, of how actions planned by California water managers could reduce the gap between supplies and demands. The evaluation does not present potential measures to reduce all shortages statewide to zero in 2020. Such an approach would not reflect economic realities and current planning by local agencies. Not all areas of the State and not all water users can afford to reduce drought year shortages to zero. Bulletin 160-98 focuses on compiling those options that appear to have a reasonable chance of being implemented by water suppliers, to illustrate potential progress in reducing the State's future shortages.

Bulletin 160-98 estimates that California's water shortages at a 1995 level of development are 1.6 maf in average water years, and 5.1 maf in drought years. (As described later in the Bulletin, shortages represent the difference between water supplies and water demands.) The magnitude of shortages shown for drought conditions in the base year reflects the cutbacks in supply experienced by California water users during the recent six-year drought. Bulletin 160-98 forecasts increased shortages by 2020—2.4 maf in average water years and 6.2 maf in drought years. The future water management options identified as likely to be implemented could reduce those shortages to 0.2 maf in average water years and 2.7 maf in drought years.

The accompanying sidebar summarizes key statistics developed later in the Bulletin, to provide the reader with an overview of California's water uses.

California—An Overview

Figure 1-1 shows California's size relative to that of the contiguous 48 states. California is the nation's most populous state and is also the top-ranked state in dollar value of agricultural production. Although California's present population is over 33 million people, the State still has large areas of open space and

Summary of Key Statistics

Shown below for quick reference are some key statistics presented in Chapter 4. Water use information is based on average water year conditions. The details behind the statistics are discussed later.

	1995	*2020 Forecast*	*Change*
Population (million)	32.1	47.5	+15.4
Irrigated crops (million acres)	9.5	9.2	-0.3
Urban water use (maf)	8.8	12.0	+3.2
Agricultural water use (maf)	33.8	31.5	-2.3
Environmental water use (maf)	36.9	37.0	+0.1

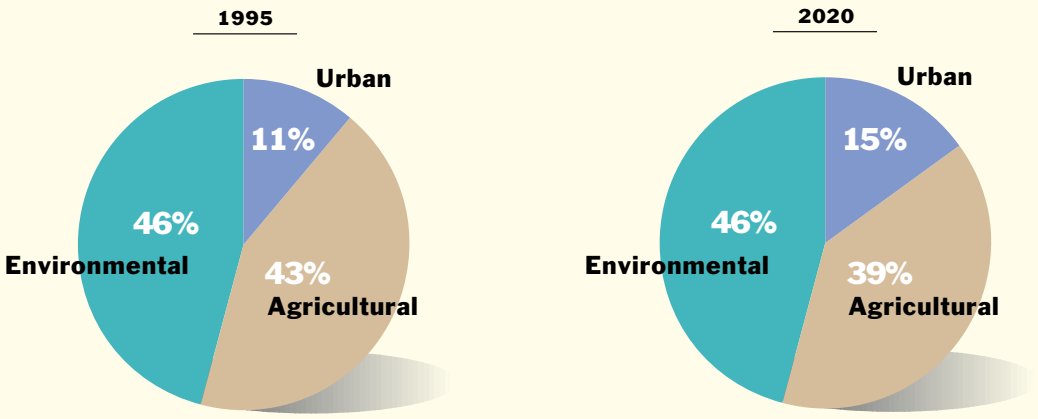


FIGURE 1-1.
California in Relation to the United States

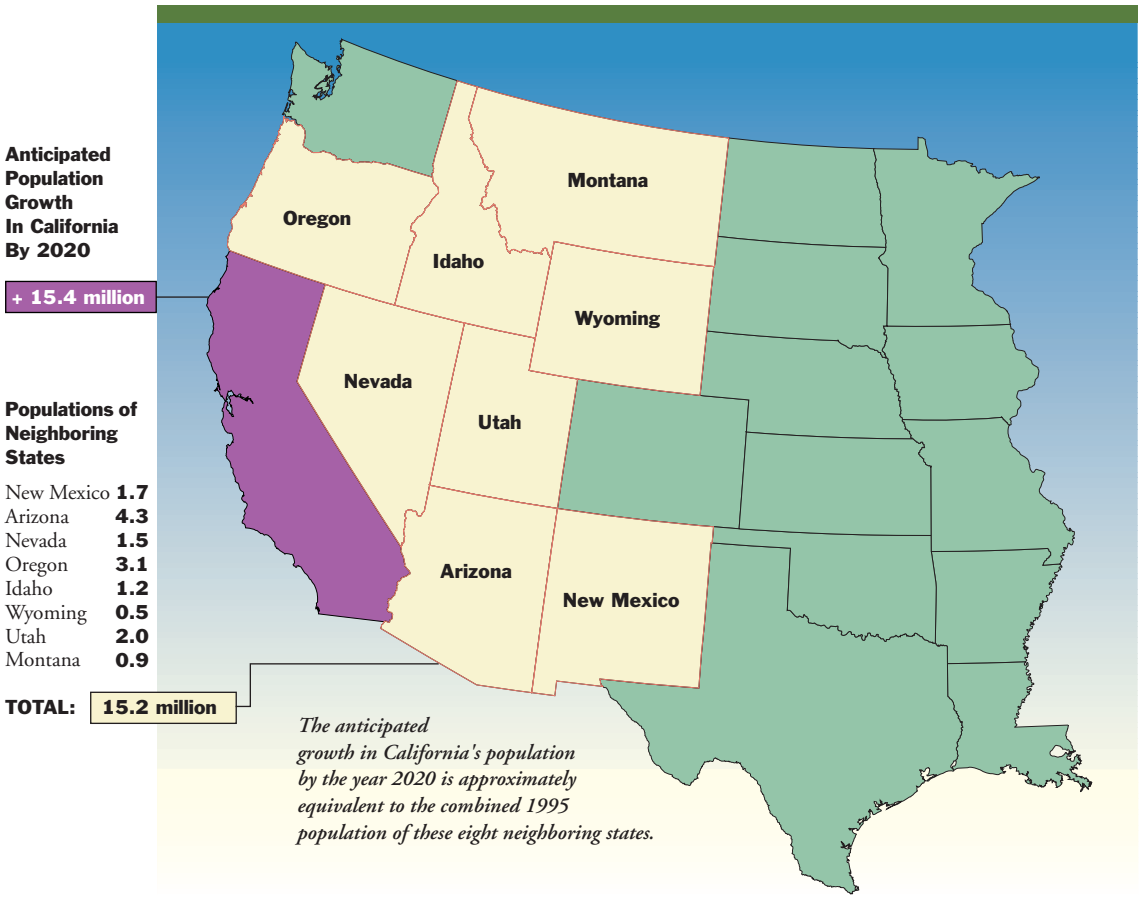
lands set aside for public use and enjoyment, including 18 national forests, 23 units of the national park system, and 355 units of the state park system. California is a state of great contrasts. Population density ranges from over 16,000 people per square mile in the City and County of San Francisco to less than 2 people per square mile in Alpine County. The highest (Mount Whitney) and lowest (Death Valley) points in the contiguous United States are located not far from each other in California. The State's average annual precipitation ranges from more than 90 inches on the North Coast to about 2 inches in Death Valley.

To put California's population into perspective, about one of every eight U.S. residents now lives in California. During the time period covered in the Bulletin (the 25 years from 1995 to 2020), California's population is forecast to increase by more than 15 million people, the equivalent of adding the present populations of Arizona, Nevada, Oregon, Idaho, Montana, Wyoming, New Mexico, and Utah to California,

Yosemite National Park is one of the U.S. Park Service's most popular facilities. Here, Half Dome is seen from the Merced River.

FIGURE 1-2.

California's Expected Population Growth Versus Neighboring States' Populations



as shown in Figure 1-2. Today, four of the nation's 15 largest cities (Los Angeles, San Diego, San Jose, and San Francisco) are located in the State.

California's population and abundant natural resources have helped create the State's trillion-dollar economy which, according to the California Trade and Commerce Agency, ranks seventh among world economic powers. California's water resources have helped it maintain its status as the nation's top agricultural state for 50 consecutive years. It is the nation's leading agricultural export state, the sixth largest agricultural exporter in the world, the nation's number one dairy state, and the producer of 55 percent of the nation's fruits, nuts, and vegetables. California is the primary U.S. producer of specialty crops such as almonds, artichokes, dates, figs, kiwifruit, olives, pistachios, and walnuts. Ten of the top 15 agricultural counties in the U.S. are in California.

Despite the State's increasing human population, many species of wildlife still call California home. Some of the larger animal species that frequently coexist with suburban development, like this opossum, are nocturnal. Suburban residents thus may not realize how widespread these species are.

Mount Shasta, a Cascade Range volcano, dominates the horizon in the northern Sacramento Valley.

California is a state of diverse climates and landforms. Figure 1-3 is a relief map of California illustrating the State's major geomorphic provinces. In roughly north to south order, major geomorphic features are: the Klamath Mountains, Modoc Plateau, Cascade Range, Central Valley, Sierra Nevada, Coast Range, Great Basin, Transverse Ranges, Mojave Desert, Peninsular Ranges, and Colorado River Desert.

The Klamath Mountains are a rugged mountain range on the California-Oregon border. To the east, the Cascade Range is a chain of volcanic cones that stretches from California into Washington. Until the 1980 eruption of Mount St. Helens in Washington, Mount Lassen (the southernmost of the Cascade volcanos) was the most recently active volcano in the United States outside of Alaska and Hawaii. The Modoc Plateau to the east of the Cascade Range is the southernmost part of a broad area of lava flows and small volcanic cones covering much of eastern Oregon and southeastern Washington. The Pit River, a major Sacramento River tributary, winds through the Modoc Plateau and crosses the Cascade Range between two of its major volcanos—Shasta and Lassen.

The Central Valley is an alluvial basin over 400 miles long by about 50 miles wide, bounded by the Coast Range on the west and the Sierra Nevada on the east. Except for the Tulare Lake drainage at the southern end of the valley (a closed drainage basin), rivers draining the Sierra Nevada flow onto the valley floor, join with the Sacramento or San Joaquin Rivers, and flow through a gap in the Coast Range to San Francisco Bay. The Central Valley provides about

FIGURE 1-3.

Relief Map of California

80 percent of the State's agricultural production. The Sierra Nevada is a fault block mountain range whose western slopes are marked by deep river-cut canyons. Sierran rivers furnish much of California's developed surface water supplies.

The Coast Ranges are bounded on the north by the Klamath Mountains and on the south by the Transverse Ranges. The San Andreas Fault is a prominent geologic feature of the Coast Ranges; its path can readily be traced in areas where faulting has controlled the direction of watercourses such as the Gualala River on the North Coast. The San Andreas Fault extends into the San Bernardino Mountains of the Transverse Ranges geomorphic province (so called because these mountain ranges trend east-west). The Peninsular Ranges (which trend north-south) are a cluster of ranges separated by long valleys dividing, for example, the Riverside area from the Los Angeles coastal plain.

The western edge of the Mojave Desert is delineated by the Garlock Fault and by a portion of the San Andreas Fault. The Mojave is a region of interior drainage characterized by large areas of alluvium with scattered areas of recent volcanic features. The Mojave has numerous playa lakes, including Silver Lake, the terminus of the Mojave River. The Colorado River Desert to the south, also a closed drainage basin, is a lower elevation desert whose most prominent feature is the Salton Sea, which occupies a structural trough. The Great Basin (also called the Basin and Range province) begins on the east side of California's Sierra Nevada and extends across Nevada and into Utah. Also a region of interior drainage, it is characterized by fault block mountain ranges separated by roughly north-south trending valleys, such as Owens Valley and Death Valley.

Figure 1-4 shows the location of the State's major water projects. The federal Central Valley Project is the largest water project in California and the Department's State Water Project is the second largest. (Descriptions of these, and of some of the larger local water projects, are provided in Chapter 3.) The

Looking out toward the floor of Death Valley from Zabriskie Point. Borate minerals concentrated by centuries of evaporation on the valley floor were mined here in the 1800s and hauled from the valley by mule teams.

California's Largest Water Retailers

Shown below are some of the largest annual retail water deliveries by local agencies, to illustrate the magnitude of urban and agricultural water demands. Retail delivery is the water supplied to an individual urban or agricultural customer. (Local agencies that wholesale water, such as Metropolitan Water District of Southern California or the City and County of San Francisco, have larger annual deliveries than the amounts shown here.)

Historical Maximum Annual Retail Water Deliveries

Water Agency	*Year*	*Delivery (taf)*
Agricultural		
Imperial Irrigation District	1996	2,846
Westlands Water District	1984	1,444
Glenn-Colusa Irrigation District	1984	831
Turlock Irrigation District	1976	687
Fresno Irrigation District	1995	627
Urban		
Los Angeles Department of Water and Power	1986[a]	706
City of San Diego	1989	257
East Bay Municipal Utility District	1976	249
San Jose Water Company	1987	128
City of Fresno	1996	125

[a] For fiscal year from July 1986 to June 1987.

FIGURE 1-4.

California's Major Water Projects

sidebars highlight California's largest waterbodies and provide information on historic water deliveries by California's largest water retailers, to provide a perspective on California's water resources and water use.

Bulletin 160-98 Hydrologic Regions

Figure 1-5 shows California's hydrologic regions. The Department subdivides the State into regions for planning purposes. The largest planning unit is the hydrologic region, a unit used extensively in this Bulletin. California has ten hydrologic regions, corresponding to the State's major drainage basins. The next level of delineation below hydrologic regions is the planning subarea. Some of the regional water management plans in Chapters 7-9 discuss information at the PSA level. The smallest study unit used by the Department is the detailed analysis unit. California is divided into 278 DAUs. Most of the Department's

California Water Statistics

California's Largest Lakes, Reservoirs, and Rivers

Natural (Undammed) Lakes

Lake	Storage Capacity (taf)	Comments
Salton Sea	7,500	At water surface elevation of -226 feet. This is a saline lake.
Mono Lake	2,620	At water surface elevation of 6,383.2 feet. This lake is also saline.
Eagle Lake	640	At water surface elevation of 5,107 feet. Has no outlet and is somewhat alkaline.
Goose Lake	475	At water surface elevation of 4,700 feet. Partly in Oregon. The lake is alkaline.

Reservoirs Constructed at Sites Not Previously Occupied by Pre-existing Natural Lakes

Reservoir	Capacity (taf)	Owner
Shasta	4,552	USBR
Oroville	3,538	DWR
Trinity	2,448	USBR
New Melones	2,420	USBR

Reservoirs Constructed by Damming Pre-existing Natural Lakes

Reservoir	Capacity (taf)[a]	Owner
Lake Tahoe	745	USBR
Clear Lake (Modoc County)	451	USBR
Clear Lake (Lake County)	315	YCFCWCD[b]

Rivers

Based on average annual runoff (maf)	
Sacramento River	22.4
Klamath River	11.1
San Joaquin River	6.4
Eel River	6.3

Based on watershed area (square miles)	
Sacramento River	26,548
San Joaquin River	15,946
Klamath *(California portion only)*	10,020
Amargosa River *(California portion only)*	6,442

[a] Storage capacity shown is the operable capacity of the reservoir, not the total capacity of the lake.

[b] Yolo County Flood Control and Water Conservation District

FIGURE 1-5.

California's Hydrologic Regions

California's Hydrologic Regions

North Coast	Klamath River and Lost River Basins, and all basins draining into the Pacific Ocean from the Oregon stateline southerly through the Russian River Basin.
San Francisco Bay	Basins draining into San Francisco, San Pablo, and Suisun Bays, and into Sacramento River downstream from Collinsville; western Contra Costa County; and basins directly tributary to the Pacific Ocean below the Russian River watershed to the southern boundary of the Pescadero Creek Basin.
Central Coast	Basins draining into the Pacific Ocean below the Pescadero Creek watershed to the southeastern boundary of Rincon Creek Basin in western Ventura County.
South Coast	Basins draining into the Pacific Ocean from the southeastern boundary of Rincon Creek Basin to the Mexican boundary.
Sacramento River	Basins draining into the Sacramento River system in the Central Valley (including the Pit River drainage), from the Oregon border south through the American River drainage basin.
San Joaquin River	Basins draining into the San Joaquin River system, from the Cosumnes River Basin on the north through the southern boundary of the San Joaquin River watershed.
Tulare Lake	The closed drainage basin at the south end of the San Joaquin Valley, south of the San Joaquin River watershed, encompassing basins draining to the Kern, Tulare, and Buena Vista Lakebeds.
North Lahontan	Basins east of the Sierra Nevada crest, and west of the Nevada stateline, from the Oregon border south to the southern boundary of the Walker River watershed.
South Lahontan	The closed drainage basins east of the Sierra Nevada crest, south of the Walker River watershed, northeast of the Transverse Ranges, north of the Colorado River Region. The main basins are the Owens and the Mojave River Basins.
Colorado River	Basins south and east of the South Coast and South Lahontan regions; areas that drain into the Colorado River, the Salton Sea, and other closed basins north of the Mexican border.

Bulletin 160 analyses begin at the DAU level, and the results are aggregated into hydrologic regions for presentation.

Some Trends in California Water Management Activities

Key dates in California's water history are shown in the sidebar. The late 1940s through the 1970s was a period of significant expansion of the State's infrastructure, in response to California's post-World War II population boom. During this time, the State expanded its highway system, constructed the State Water Project, and established a blueprint for a higher education system. At the federal level, many of the Central Valley Project's major facilities were constructed. There was substantial State and federal government involvement in—and funding for—water resources development, including direct financial assistance to local agencies for constructing water supply infrastructure (such as the Davis-Grunsky Act and Small Reclamation Projects Act programs).

The emergence of the environmental movement in the latter part of the 1960s began to effect a change in society's values, increasing the desire to preserve natural areas in a relatively undeveloped condition. With enactment of a number of environmental protection statutes, the State and federal governments' roles in water began to shift from development to management and regulation. In the 1970s, the "taxpayer revolt", typified by voter support for Proposition 13, reduced available funding to local agencies. (Two recent influences on funding sources for resources programs include deficit reduction goals for the federal budget and voter approval of Proposition 218, a measure to limit the ability of local governments to levy assessments.) There was a reduction in construc-

A California Water Chronology

In 2000, California will celebrate its sesquicentennial (150 years of statehood). Within this relatively short time period, the State's major water infrastructure and complex institutional framework for managing water have been developed. The following chronology highlights some key points in California's water history.

1848 Treaty of Guadalupe Hidalgo transfers California from Mexico to the U.S.
1848 Gold is discovered at Sutter's Mill on the American River.
1850 California is admitted to the Union.
1871 First reported construction of a dam on Lake Tahoe.
1884 Hydraulic mining is banned because of its impacts on navigation and contribution to flooding.
1886 Lux v. Haggin addresses competing water rights doctrines of riparianism and prior appropriation.
1887 Legislature enacts Wright Irrigation District Act, allowing creation of special districts.
1887 Turlock Irrigation District becomes first irrigation district formed under the Wright Act.
1895 World's first long-distance transmission of electric power (22 miles), from a 3,000 kW hydropower plant at Folsom to Sacramento.
1902 Congress enacts the Reclamation Act of 1902, creating the Reclamation Service, and authorizing federal construction of water projects.
1905 Salton Sea is created when the Colorado River breaches an irrigation canal and flows into the Salton Trough.
1913 First barrel of Los Angeles Aqueduct completed.
1914 California's present system of administering appropriative water rights is established by the Water Commission Act.
1922 Colorado River Compact signed.
1928 California Constitution amended to prohibit waste of water and to require reasonable beneficial use.
1928 Saint Francis Dam fails.
1929 State dam safety program goes into effect.
1929 East Bay MUD's Mokelumne River Aqueduct is completed.
1934 San Francisco's Hetch Hetchy Aqueduct is completed.
1940 All American Canal is completed.
1941 Colorado River Aqueduct is completed.
1945 Shasta Dam is completed.
1957 The Department publishes Bulletin 3, the *California Water Plan*.
1960 California voters approve the Burns-Porter Act, authorizing the sale of bonds to finance State Water Project construction.
1968 Oroville Dam is completed.
1968 Congress enacts National Wild and Scenic Rivers Act.
1969 Legislature enacts Porter-Cologne Act, the foundation of California water quality regulatory programs.
1969 Congress enacts National Environmental Policy Act.
1970 Legislature enacts California Environmental Quality Act.
1972 Legislature enacts California Wild and Scenic Rivers Act.
1973 California Aqueduct is completed.
1978 California v. U.S. held that the U.S. must obtain water rights under State law for reclamation projects, absent clear congressional direction to the contrary.
1978 SWRCB issues Decision 1485, requiring the CVP and SWP to meet specified Bay-Delta operating criteria.
1983 National Audubon Society v. Superior Court sets forth the application of public trust concepts to water rights administered by SWRCB.
1990 Congress enacts the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (PL 101-618).
1992 Congress enacts the Central Valley Project Improvement Act (PL 102-575).
1994 SWRCB issues Decision 1631, requiring specified protections for Mono Lake levels.
1994 Bay-Delta Accord signed; its original three-year term was subsequently extended to a total of four years.

The founding of the San Diego Mission in 1769 is considered to mark the beginning of California's water supply development. This 1918 photo shows the ruins of the mission's dam.

Courtesy of Water Resources Center Archives, University of California, Berkeley

tion of large-scale water projects from the 1980s onward. The result of these changing circumstances was that few large-scale water management actions were able to move forward after the late 1960s. Since there is a long lead time for developing large water supply projects, the consequences were not immediately felt.

A theme now dominating much water management planning at the statewide level is ecosystem restoration (accompanied by substantial funding). Bay-Delta actions are an example of this trend—voter approval of Proposition 204 provided $460 million for State restoration actions directly associated with the Delta, and another $93 million in State matching funds for the U.S. Bureau of Reclamation's Central Valley Project Improvement Act restoration actions. USBR's annual budget for CVPIA restoration actions covered by the Restoration Fund has been in the $40 million range. Other examples of funding for environmental restoration actions are described throughout the Bulletin.

Greater local government and other stakeholder participation in statewide-level water management decision-making is an emerging trend. Formal governance structures are being employed to coordinate and manage the collective actions of local agencies. For example, CVP water users formed three joint powers authorities to contract with USBR for operation and maintenance of CVP facilities. Those JPAs have been working with USBR to develop mechanisms to allow the JPAs to finance normal operations and maintenance activities, rather than going through the congressional appropriations process. Another JPA has been formed by two county governments and two water agencies to implement Salton Sea restoration actions.

Changes Since the Last California Water Plan Update

The last *California Water Plan* update, Bulletin 160-93, was published in 1994 and used 1990-level information to represent base year water supply and demand conditions. At that time, California had recently emerged from the six-year drought and Bay-Delta issues were in a state of flux. Bulletin 160-98 uses 1995-level information to represent base year conditions, including new (interim) Bay-Delta standards.

Changes in Delta conditions are a major difference between the two bulletins. Bulletin 160-93 was based on SWRCB D-1485 regulatory conditions in the Delta, and used a range of 1 to 3 maf for unspecified future environmental water needs—a range that reflected uncertainties associated with Bay-Delta water needs and Endangered Species Act implementation. Bulletin 160-98 uses SWRCB's Order WR 95-6 as the base condition for Bay-Delta operations, and describes proposed CALFED actions for the Bay-Delta.

Bulletin 160-93 was the first *California Water Plan* update to examine the demand/supply balance for drought water years as well as for average water years, a response to water shortages experienced during the then-recent drought. Bulletin 160-98 retains the drought year analysis and also considers the other end of the hydrologic spectrum—flooding. Traditionally, water supply has been the dominant focus of the water plan updates. In response to the January 1997 flooding in Northern and Central California, Bulletin 160-98 highlights common areas in water supply and flood control planning and operations and emphasizes the benefits of multipurpose facilities.

Agreements reached in the 1994 Bay-Delta Accord were widely hailed as a truce in California's water wars. The approach taken in the Bay-Delta exemplifies some hallmarks of today's water management activities—increased participation by local governments and other stakeholders in statewide water management issues, and significant efforts to carry out ecosystem restoration actions.

Changes in Response to Bulletin 160-93 Public Comments

Other changes between the two reports resulted from public comments on Bulletin 160-93. The dominant public comment on Bulletin 160-93 was that it should show how to reduce the gap between existing supplies and future demands, in addition to making supply and demand forecasts. Bulletin 160-98 addresses that comment by presenting a compilation of local agencies' planning efforts together with potential water management options that are statewide in scope. Local agencies' plans form the base for this effort, since it is local water purveyors who have the ultimate responsibility for meeting their service areas' needs. About 70 percent of California's developed water supply is provided by local agencies.

Bulletin 160-98 excludes groundwater overdraft from the Bulletin's base year water supply estimate and is therefore the first water plan update to show an average water year shortage in its base year. (Both of the bulletins excluded future groundwater overdraft from future water supply estimates.) About 1.5 maf of the 1.6 maf base year shortage is attributable to groundwater overdraft.

Finally, Bulletin 160-98 uses applied water data, rather than the net water amounts historically used in the water plan series. This change was made in response to public comments that net water data were more difficult to understand than applied water data. This concept is explained in Chapter 4.

Changes in Future Demand/Shortage Forecasts

Bulletin 160-93 used a planning horizon of 1990-2020. Bulletin 160-98 uses a planning horizon of 1995-2020. Bulletin 160-98 uses the 2020 planning horizon because no major data changes occurred between the two reports that would justify extending the planning horizon. Urban water demands depend heavily on population forecasts—the next U.S. Census will not be conducted until 2000. Appendix 1A compares some key 2020 average year forecasts from the two bulletins.

The water plan series uses population forecasts from the Department of Finance. DOF reduced its

Flooding and threatened flooding triggered the evacuation of thousands of people in the greater Yuba City/Marysville area during the January 1997 storms.

2020 forecast for California in the period between Bulletin 160-93 and Bulletin 160-98. The reduction reflects the impacts of the economic recession in California in the early 1990s. California experienced a record negative net domestic migration then, as more people moved out of the State than moved in. This reduction in the population forecast translates to a reduction in forecasted urban water use in Bulletin 160-98.

The 2020 forecasted agricultural water demands increased from Bulletin 160-93 to Bulletin 160-98, even though the forecasted crop acreage decreased slightly. This increase resulted from elimination of the "other" category of water use shown in Bulletin 160-93, which included conveyance losses. For Bulletin 160-98, water in the "other" category was reallocated to the major water use categories to simplify information presentation. Most of the conveyance losses are associated with agricultural water use. Combining the "other" category into the major water use categories most affected the agricultural water demand forecast. As shown in Appendix 1A, when conveyance losses are factored out of the Bulletin 160-98 forecast, agricultural water use decreases between Bulletin 160-93 and Bulletin 160-98.

Bulletin 160-93 was the first water plan update to quantify environmental water use, recognizing the importance of the water that is dedicated to environmental purposes and that this water is unavailable for future development for other purposes. As illustrated earlier, the environmental sector is California's largest water using sector. Bulletin 160-98 uses the same definition and quantification procedure for environmental water use as did Bulletin 160-93.

The 2020 environmental water demand forecast increased substantially from Bulletin 160-93 to Bulletin 160-98. This increase results from implementation of the Bay-Delta Accord, inclusion of additional wild and scenic river flows, and increased instream flow requirements.

The shortage shown in Bulletin 160-98 is similar in magnitude to the low end of the shortage range reported in Bulletin 160-93. The treatment of forecasted Bay-Delta environmental water demands accounts for much of the difference. A 1 to 3 maf range of potential future environmental water demands was added to the Bulletin 160-93 base environmental water demand forecast, rather than being evaluated through operations studies, because Bay-Delta regulatory assumptions could not be determined then. This conservative approach yielded higher demands than operations studies would have provided. (Use of operations studies to calculate water supply requirements is explained in Chapter 3.)

Preparation of Bulletin 160-98

Although the water plan updates are published only every five years, the Department continuously compiles and analyzes the annual data used to prepare them. After publication of Bulletin 160-93 in 1994, the remainder of that year was devoted to finishing data evaluation deferred during the Bulletin's production. Work on Bulletin 160-98 began in 1995. A citizen's advisory committee with more than 30 members, representing a wide range of interests, was established to assist the Department in its preparation of the next water plan update. The advisory committee met with Department staff 17 times over the period of Bulletin 160-98 preparation, and in August 1997 reviewed an administrative draft that preceded release of the public review draft at the end of January 1998. The review period for the public draft extended through mid-April 1998, during which time public meetings were held and presentations were made to interested parties. The draft was also made available on the World Wide Web. Over 4,000 copies of the public review draft were distributed. Comments received on the public review draft were addressed in the final version of the Bulletin.

Public Comments on Draft

The Department received over 200 comment letters on the draft and additional comments from public meetings. A summary of the comments is provided in Appendix 1B. Many comments were provided by local agencies whose facilities and projects are described in the public draft, and dealt with edits or corrections regarding those facilities or projects. Another major class of comments dealt with policy, conceptual, or analytical subjects. Many of these comments were influenced by discussions taking place in the CALFED Bay-Delta program and reflected the commenters' positions on CALFED issues. For example, proponents of CALFED's no conveyance improvements alternative generally expressed opposition to Bulletin 160-98's exclusion of groundwater overdraft as a supply, because this approach increases overall statewide shortages. The Department received positive public comments on Bulletin 160-93 when it excluded groundwater over-

draft as a supply for the first time, and also received positive comments on its treatment of overdraft for Bulletin 160-98.

Often, public comments conflicted with one another. For example, environmental organizations frequently stated that the Bulletin should include more future water conservation, while water purveyors frequently stated that levels assumed in the Bulletin were overly optimistic. Some comments suggested that the Bulletin's future water demands could be reduced by raising water prices, while others felt that the forecasted demands were too low and did not take into account future needs of California's population and agricultural economy. Likewise, some comments expressed philosophical opposition to constructing more reservoirs in California, while others emphasized the need for more storage and flood control reservoirs. The Department considered these comments in the context of the Bulletin's goal of accurately reflecting actions that water purveyors statewide would be reasonably likely to implement by year 2020.

Some comments suggested that Bulletin 160-98 (or the Department, or the State of California) advocate or express a vision on a variety of subjects—including State-funded water supply development, sustainable development, nonpoint source pollution, flood control, food production security, mandatory water pricing, and greater use of desalting (by entities other than the commenter). Such an approach is outside the scope of the Department's water plan update series. The role of the Bulletin 160 series is to evaluate present and future water supplies and demands given current social/economic policies, and to evaluate progress in meeting California's future water needs. As appropriate, the Bulletin discusses how other factors such as flood control may relate to water supply planning.

In its forecasts, the Department is making a fundamental assumption that today's conditions—facilities, programs, water use patterns, and other factors—are the basis for predicting the future. (And, as one commenter correctly pointed out, Bulletin 160-98 also assumes that California's climate will remain unchanged over the Bulletin's 25-year planning horizon.) This approach differs distinctly from the approach of establishing a desired future goal or vision, and then preparing a plan that would implement that goal or vision. Such a plan would require public acceptance that simply does not exist today.

Many of the advocacy or vision comments described above are also not within the Department's jurisdiction or the jurisdiction of other State agencies. For example, the Department's role in developing water supply for local agencies is limited to fulfilling its State Water Project contractual obligations. (The Department may provide financial assistance to local agencies for various water management programs as authorized under bond measures enacted by the Legislature and approved by the voters.) The Department has no regulatory authority to mandate how local water agencies price their water supplies, or to require that local agencies adopt one type of water management option over another. Comments such as those suggesting that the Department make plans for control of nonpoint source pollution or food production address the jurisdictional areas of other State agencies.

The subject of flood control merits special mention because of the direct relationship between operations of water supply projects and flood control projects. The purpose of the water plan update series is to evaluate water supplies, but those supplies can be affected by flood control actions such as increasing the amount of reservoir storage dedicated to flood control purposes. With memories of the disastrous January 1997 floods still fresh in peoples' minds, some commenters recommended that Bulletin 160-98 devote more attention to flood control needs, including needs such as floodplain mapping programs that are not directly related to water supply considerations. The 1997 *Final Report of the Governor's Flood Emergency Action Team* describes recommended actions to be taken based on the damages experienced in January 1997. The Department has referenced sections of that report throughout Bulletin 160-98. Bulletin 160-98 emphasizes the interaction between water supply and flood control planning, and points out the benefits associated with multipurpose water projects.

As discussed in the following section, the Department received a number of comments requesting that Bulletin 160-98 quantify future water supply uncertainties associated with ongoing programs or regulatory actions, such as the CALFED Bay-Delta program, Federal Energy Regulatory Commission hydroelectric plant relicensing, and Endangered Species Act listings. Text has been added that quantifies those actions for which data are available.

The Department also received some comments that could not be incorporated in Bulletin 160-98 because they suggested substantial changes in the scope or content of the Bulletin that could not be addressed before the Bulletin's due date to the Legislature, or

suggested changes for the next update of the water plan. The scope of Bulletin 160-98 was established in coordination with the Bulletin's advisory committee in 1995, just as the scope of the next plan update (five years hence) will have to be established early in the process of preparing that update. The Department will consider these long-term comments when work begins on the next update.

Works in Progress and Uncertainties

The descriptions of major California water management activities provided in the Bulletin are generally current through July 1998. There are several pending activities that could be characterized as works in progress, including the CALFED Bay-Delta program and Colorado River water use discussions. For programs such as these, the Bulletin describes their current status and potential impacts, if known, on future water supplies. There are uncertainties associated with the outcomes of these activities, just as there are with any process that is evaluated in mid-course.

As noted at the beginning of this chapter, each water plan update focused on issues or concerns of special interest at the time of its publication. Water use for hydroelectric power generation is a good example of this focus. Bulletin 160-83 was the last water plan update to review hydropower generation use, because no major changes have occurred since the late 1970s/early 1980s, when high energy prices and favorable tax treatment for renewable energy spurred a boom in small hydropower development. Today uncertainties about water supply and water use associated with hydropower production are increasing, with the 1998 initiation of deregulation for California investor-owned utilities and the prospect of FERC relicensing of several powerplants on major Sierra Nevada rivers between 2000 and 2010. Although there is presently little information available on which to base forecasts of resultant changes in water supplies, more information is likely to be available for the next water plan update.

Colorado River interstate issues are a new addition to a statewide water picture largely dominated by Delta and CVPIA issues in the recent past. Achieving a solution to California's need to reduce its use of Colorado River water to the State's basic apportionment (a reduction of as much as 900 taf from historical uses) requires consensus among California's local agencies that use the river's water, as well as concurrence in the plan by the other basin states.

Presentation of Data in Bulletin 160-98

Water budget and related data are tabulated by hydrologic region throughout the Bulletin. The statewide totals in these tables are generally presented as rounded values. As a result, individual table entries will not sum exactly to the rounded totals.

In the water budget appendices 6A, 6E, and 10A, regional water use/supply totals and shortages are not rounded. Individual table entries may not sum exactly to the reported totals due to rounding of individual entries for presentation purposes.

Organization of Bulletin 160-98

Chapter 2 provides an overview of recent events in California water and summarizes significant changes in statutes and programs since the publication of Bulletin 160-93. An appendix for Chapter 2 summarizes some State and federal statutes affecting water management. Chapters 3 and 4 cover water supplies and water uses. Chapter 5 describes the status of technology applications relating to water supply, reflecting the continuing public interest in topics such as potential future use of seawater desalting, status of water conservation and use technologies, or fish screening technology applications.

Chapters 6-9 focus on ways to meet California's future water needs. Chapter 6 covers statewide level water management actions, including actions such as the CALFED Bay-Delta program, SWP future water supply options, and CVPIA fish and wildlife water acquisition. Chapters 7-9 evaluate regional water management options for each of the State's ten major hydrologic regions. These regional evaluations are combined in Chapter 10 into a tabulation of actions likely to be taken to meet California's future water needs. The water budget tables in Chapter 10, shown for a 2020 level of demand with future water management options, are key summaries of the Bulletin's planning process. Appendices follow at the end of the chapters in which they are referenced. Following Chapter 10 are a brief glossary and list of abbreviations and acronyms used in the text.

An executive summary of Bulletin 160-98 is available as a separate document.